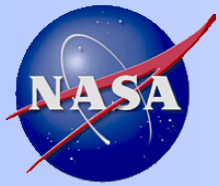


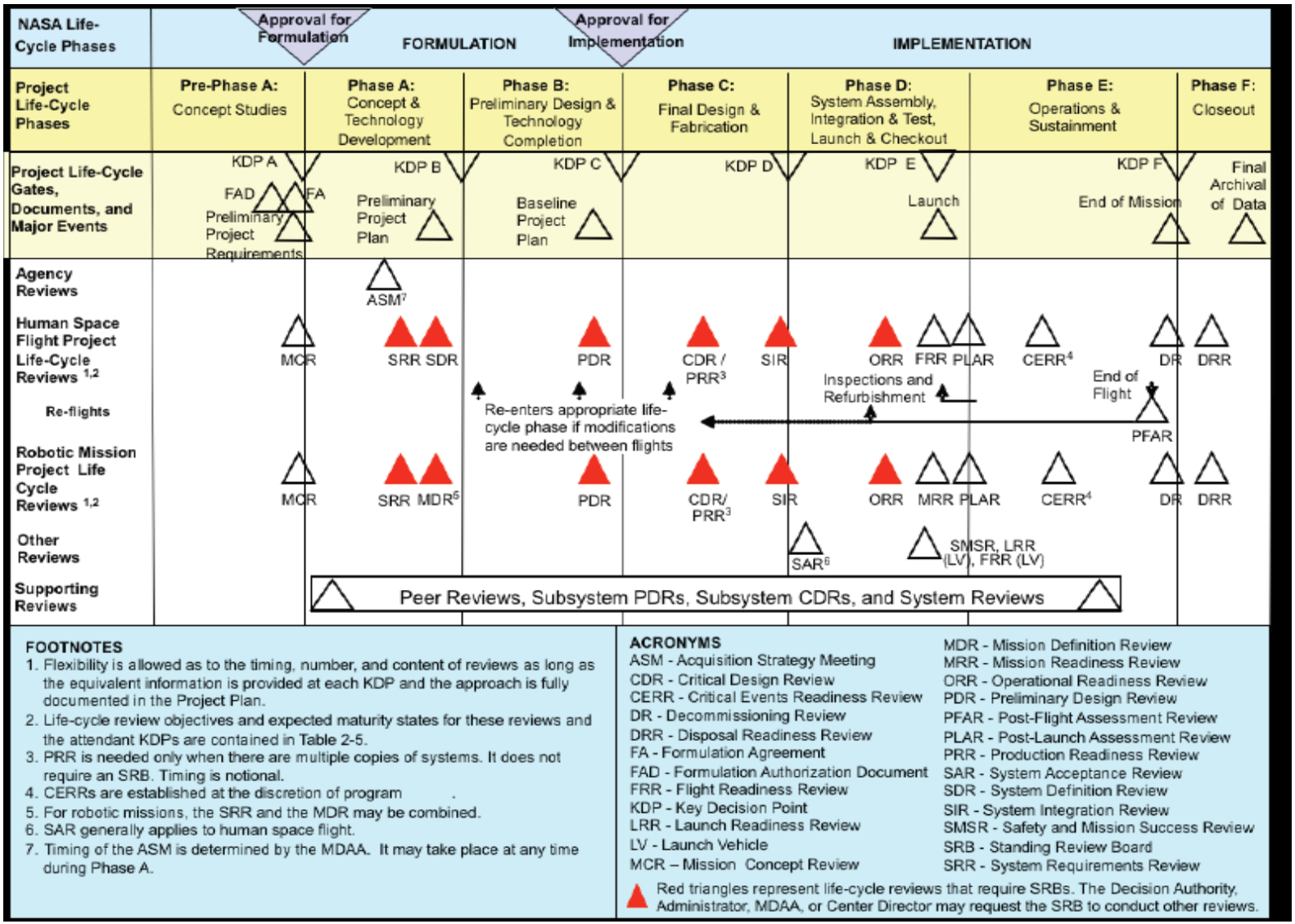
Advocate Joint Confidence Level (JCL)

Combined Resources Forum

Param Nair

June 11, 2013

The NASA Project Life Cycle



FOOTNOTES

1. Flexibility is allowed as to the timing, number, and content of reviews as long as the equivalent information is provided at each KDP and the approach is fully documented in the Project Plan.
2. Life-cycle review objectives and expected maturity states for these reviews and the attendant KDPs are contained in Table 2-5.
3. PRR is needed only when there are multiple copies of systems. It does not require an SRB. Timing is notional.
4. CERRs are established at the discretion of program .
5. For robotic missions, the SRR and the MDR may be combined.
6. SAR generally applies to human space flight.
7. Timing of the ASM is determined by the MDAA. It may take place at any time during Phase A.

ACRONYMS

ASM - Acquisition Strategy Meeting
CDR - Critical Design Review
CERR - Critical Events Readiness Review
DR - Decommissioning Review
DRR - Disposal Readiness Review
FA - Formulation Agreement
FAD - Formulation Authorization Document
FRR - Flight Readiness Review
KDP - Key Decision Point
LRR - Launch Readiness Review
LV - Launch Vehicle
MCR – Mission Concept Review
MDR - Mission Definition Review
MRR - Mission Readiness Review
ORR - Operational Readiness Review
PDR - Preliminary Design Review
PFAR - Post-Flight Assessment Review
PLAR - Post-Launch Assessment Review
PRR - Production Readiness Review
SAR - System Acceptance Review
SDR - System Definition Review
SIR - System Integration Review
SMSR - Safety and Mission Success Review
SRB - Standing Review Board
SRR - System Requirements Review

Red triangles represent life-cycle reviews that require SRBs. The Decision Authority, Administrator, MDAA, or Center Director may request the SRB to conduct other reviews.

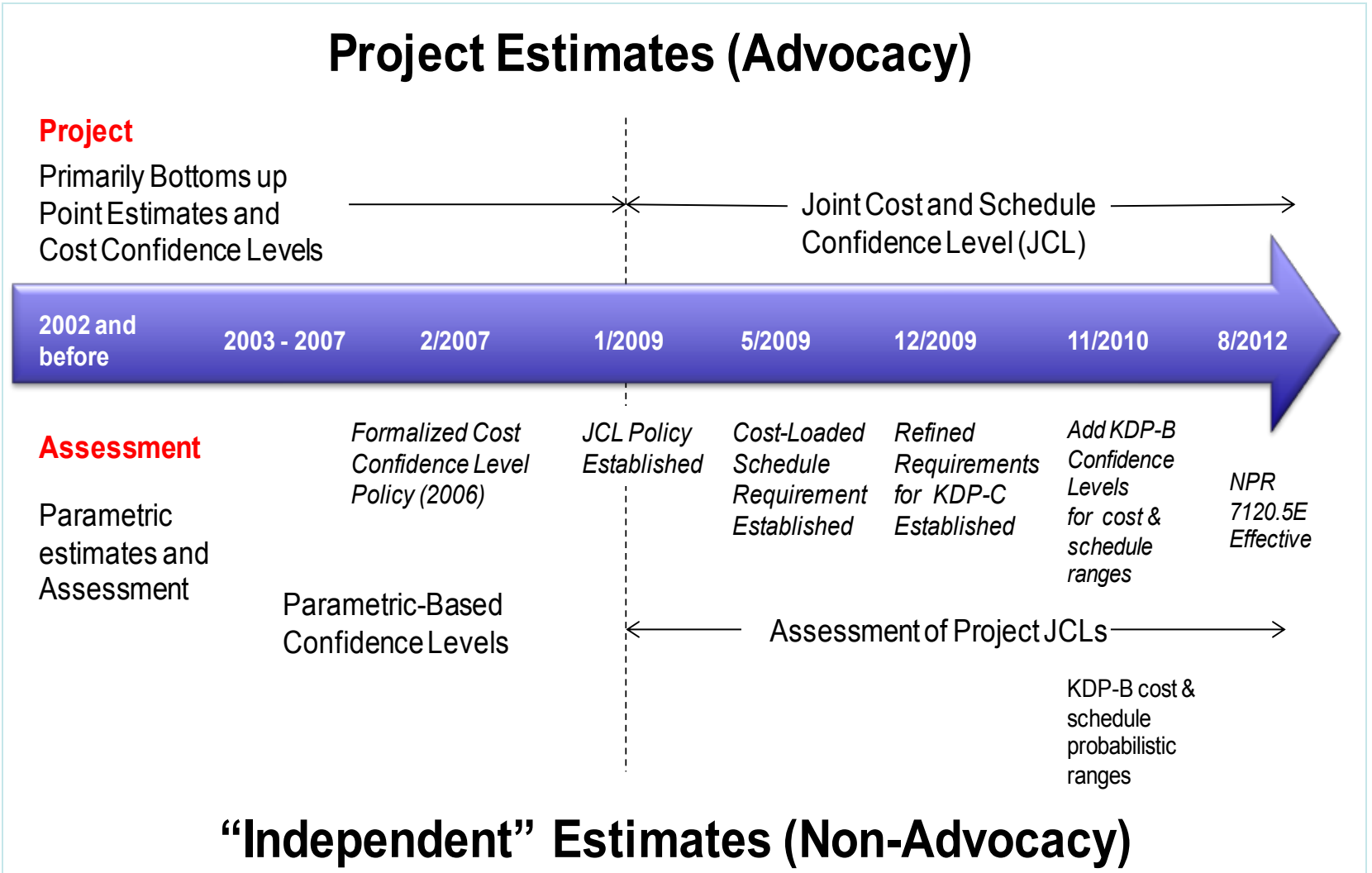
Cost and Schedule Assessments at NASA

- Advocate Cost Assessments:
  - Grass roots (based upon Full Cost Builder; can include vendor estimates)
  - Price H / SEER
  - Other?

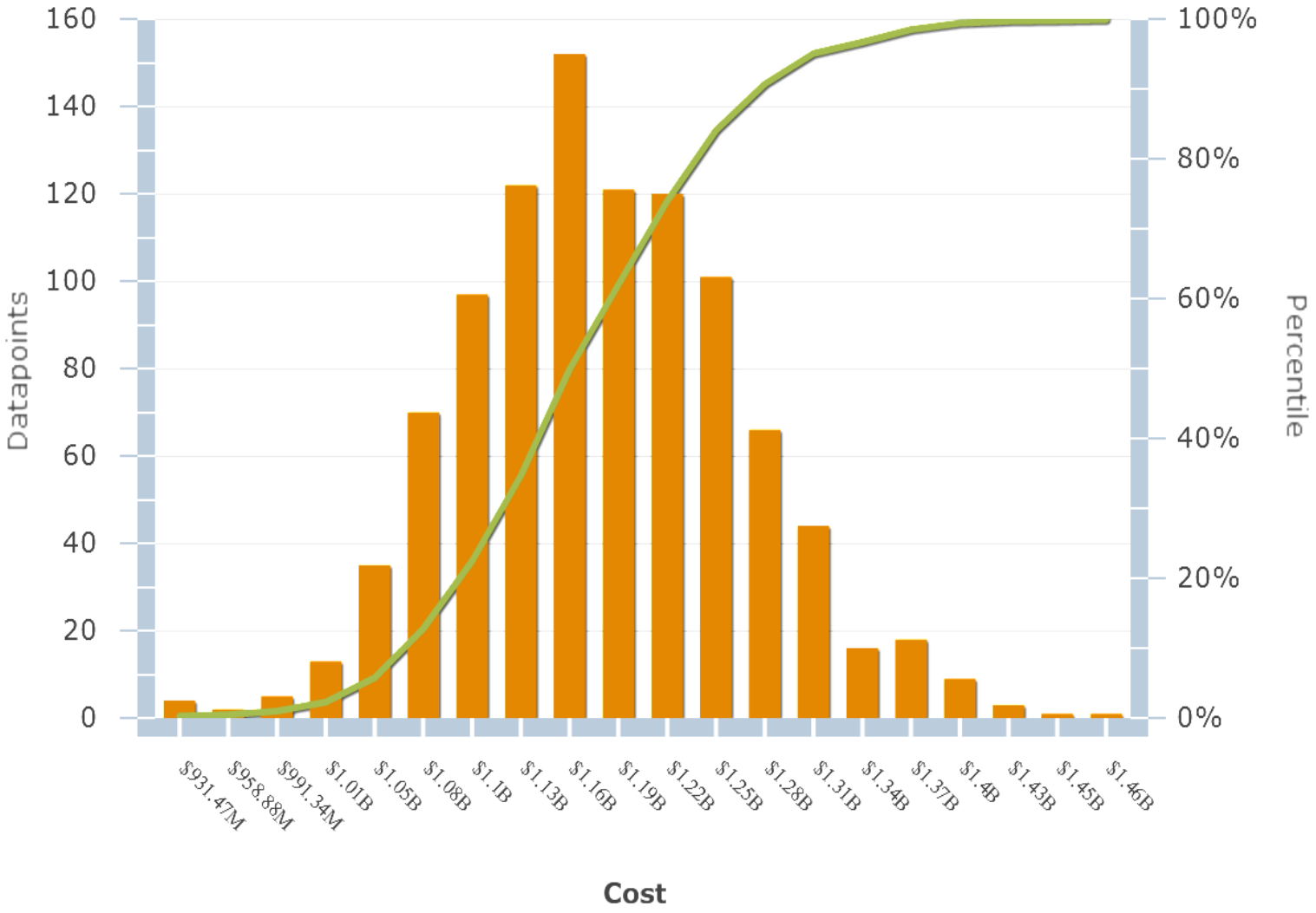
- Non Advocate Cost Assessments:
  - RAO (GSFC)
  - Project Standing Review Board (SRB)
  - Private companies (Booz Allen Hamilton, The Aerospace Corporation, SAIC, etc.)

- Schedule Assessments:
  - Analogous to Cost Assessments: both advocate and non advocate

Evolution to JCL at NASA



Cost and Schedule Assessments at NASA can be risk informed



What is JCL? What is the Agency's JCL policy?

DEFINITION: A Joint (Cost and Schedule) Confidence Level (JCL) identifies the probability that a given project's or program's cost will be equal or less then the targeted cost AND the schedule will be equal or less than the targeted schedule date.

Confidence Level (CL) is a percentage value that is the level of assurance prescribed by Agency policy that the project will have that probability of delivering Level 1 Science without any premium in cost or schedule. Current Agency policy for SMD missions is for a project controlled-budget of at least 50% and the balance to a 70% JCL held as UFE at NASA HQ. The Decision Authority can budget to lower levels but these must be justified and documented. A rebaseline also requires a fresh JCL assessment.

Primary Roles in JCL

- Project (Owner)
  - Owns JCL and probabilistic cost/schedule analysis and all products
- Code 400 and external consultants
  - JCL advocate
  - Jump start consulting for projects – project advocate
  - Flight Projects Advocate JCL Handbook
  - Models and Tools
- IPAO/SRB (Evaluator)
  - Evaluates KDP B probabilistic cost and schedule analysis
  - Evaluates the program and projects' JCL whenever a project is reviewed at KDP C or rebaselined

JCL Internal Roles

- Project Leader
  - One individual to be responsible for coordination and integration
  - Typically a DPM, or someone similar with authority
  - Should have a good understanding of Project plan including cost, schedule, and risk
- Scheduler
  - One of the most important people in the JCL effort
  - Must be familiar with current Project schedules
    - Master Schedule (1-pager, PowerPoint)
    - Integrated Master Schedule (detailed, MS Project/Primavera, etc)
  - Needs to be ready to construct/ready analysis schedule
    - Should be able to reach back to technical experts, sys eng, etc.
- Estimator or Resource Analyst
  - Must be familiar with current Project budget, cost, and resource plan(s)
  - Should have access to phased cost data
    - WBS and lower level detail
- Systems Engineer/Risk Manager
  - Must be familiar with current Project RMS
  - Able to provide details for risk register
  - Should be able to reach back to risk owners/CAMs when needed

Establish and Define Roles Early

Standard Steps in Building a JCL

1. Build a JCL schedule/logic network
   - Logic network
   - Minimize use of constraints
   - Link to major milestones
   - Schedule Health Check for viability for analysis
2. Cost Load the Schedule
   - Map cost to schedule
   - Load as resources if using schedule system
   - Determine phased fixed/variable costs and assign to schedule/logic network
3. Implement Risk List
   - Quantify likelihood and cost/schedule impacts
   - Link to schedule/network activities
   - Load risks
4. Conduct Uncertainty Analysis/Populate 5x5s
   - Schedule Uncertainty
   - Cost Uncertainty
5. View Results & Plot
6. Analyze results and refine (steps 1-5)

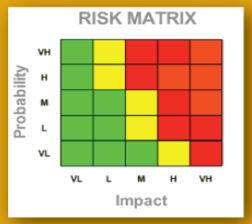
Step Zero: Identify goals for JCL
What questions to answer?
Who to use?
What insight to gather?

Project Preparation

- IPAO/SRB milestones are based on a site review date, which is based on PDR and KDP-C milestone dates
  - PDR/IAR Minus 100 days: First data drop, very preliminary
    - Provide whatever is available; goal is to provide draft analysis schedule and IMS
    - IPAO will run health checks and begin analysis of network logic
  - PDR/IAR Minus 60 days: Second data drop, still preliminary
    - Goal is to provide other data products: costs, risk lists, uncertainty factors, etc.
  - PDR/IAR Minus 20 days: Third data drop, actual results
    - Goal is to provide results that can be analyzed and discussed at the site review

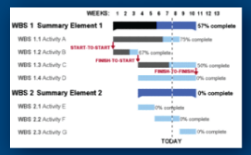
JCL Process – High Level

Risk



Collect Risk Data → Assign Likelihood Determine Impacts → Map to Schedule Activities

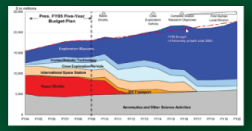
Schedule



Assess Durations

Collect Schedule Related Data → Determine High-Level Flow → Generate Analysis Schedule → Update Analysis Schedule → Incorporate Uncertainty → Validate File → Run Analysis

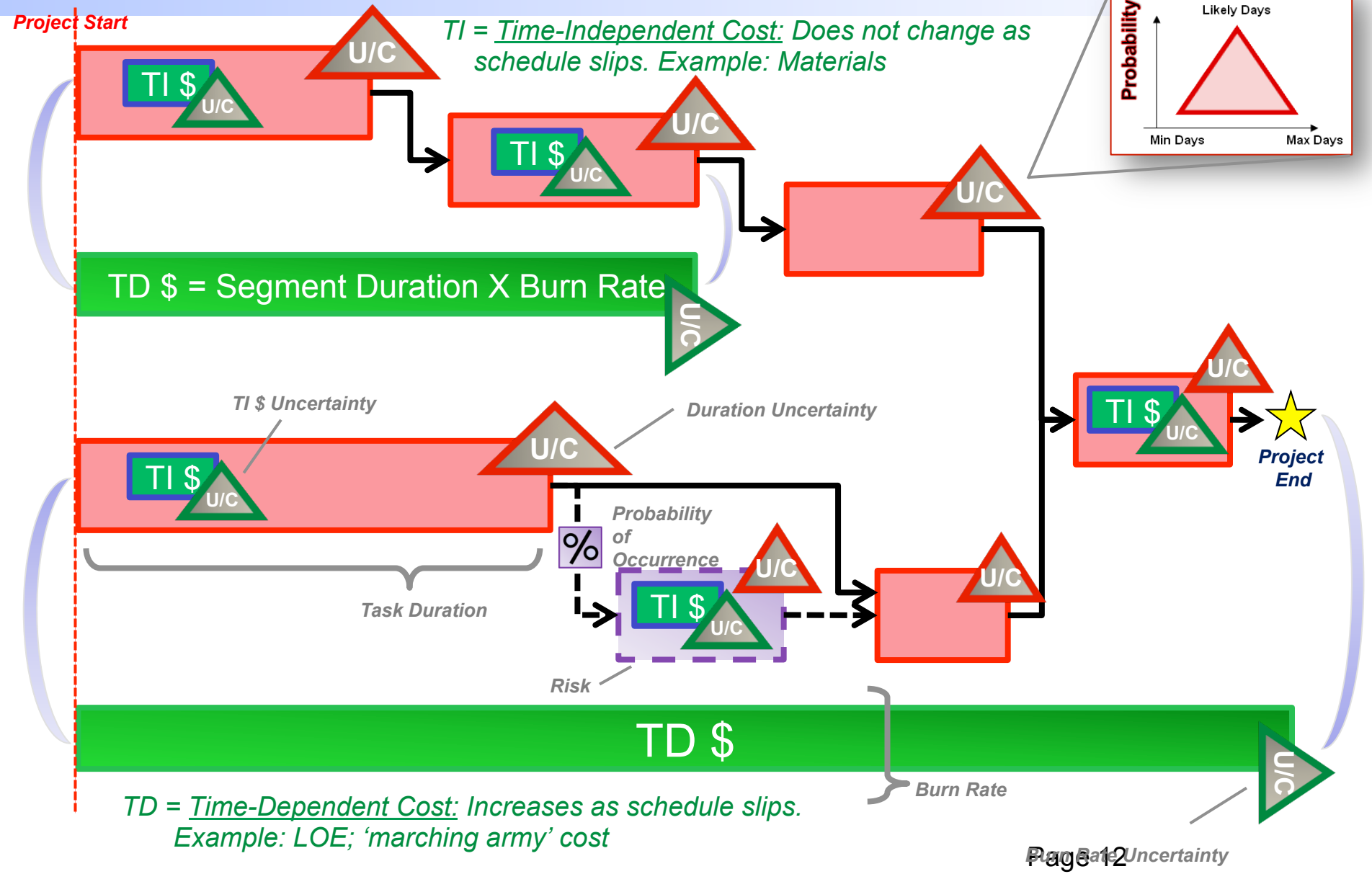
Cost



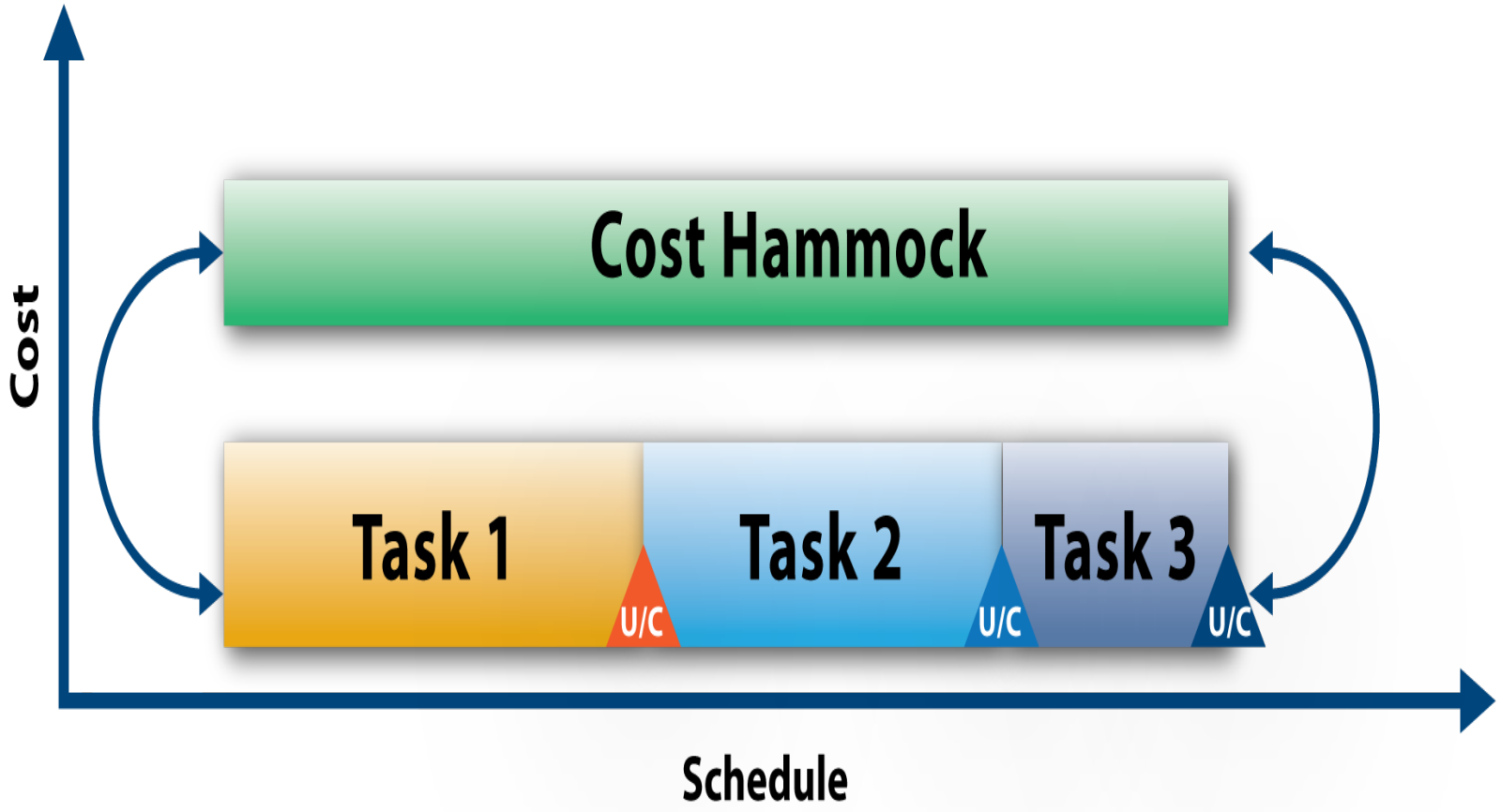
Collect Cost Data → Identify Cost Behavior (TD vs. TI) → Map to Schedule Activities → Assess Uncertainty

Time

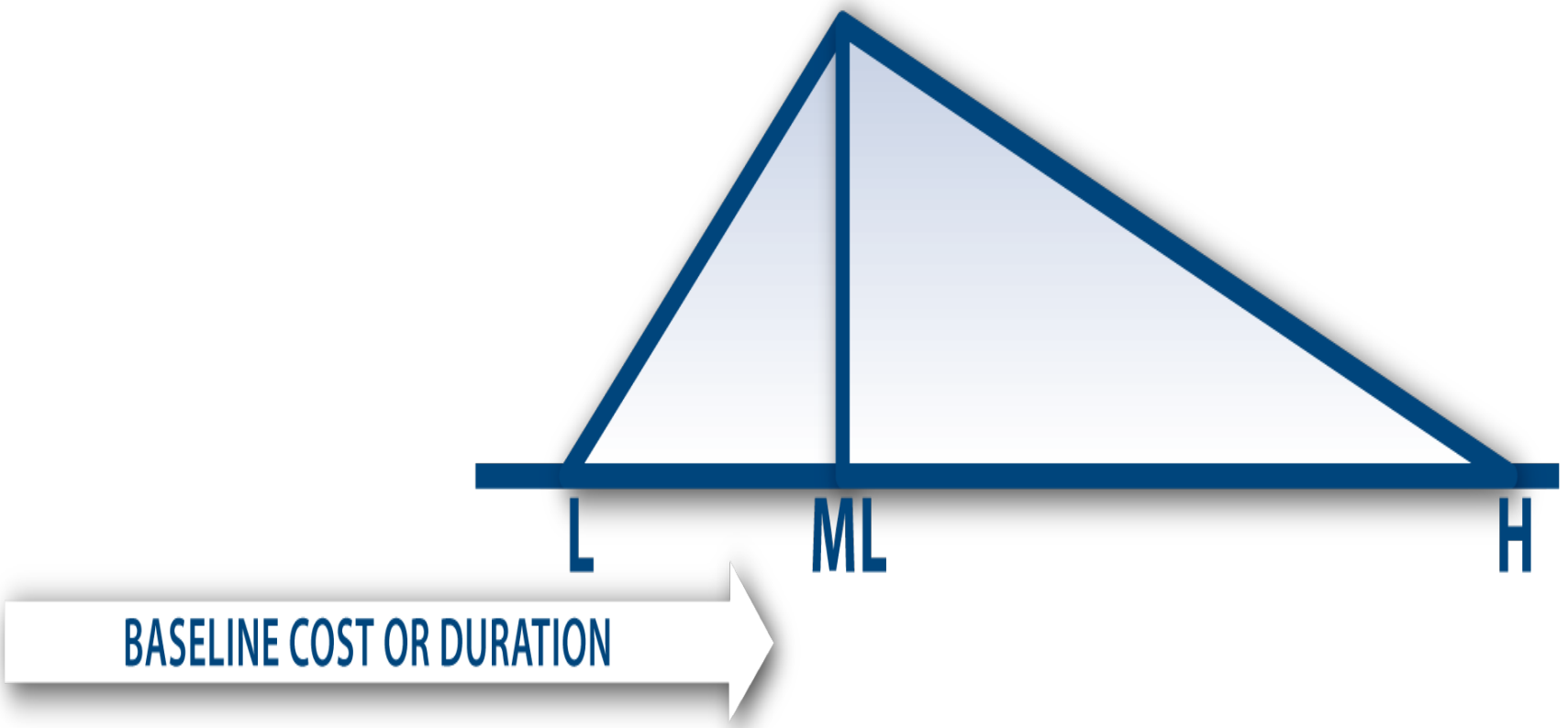
JCL: Data Integration Mechanics



Cost Mapping using Hammocks



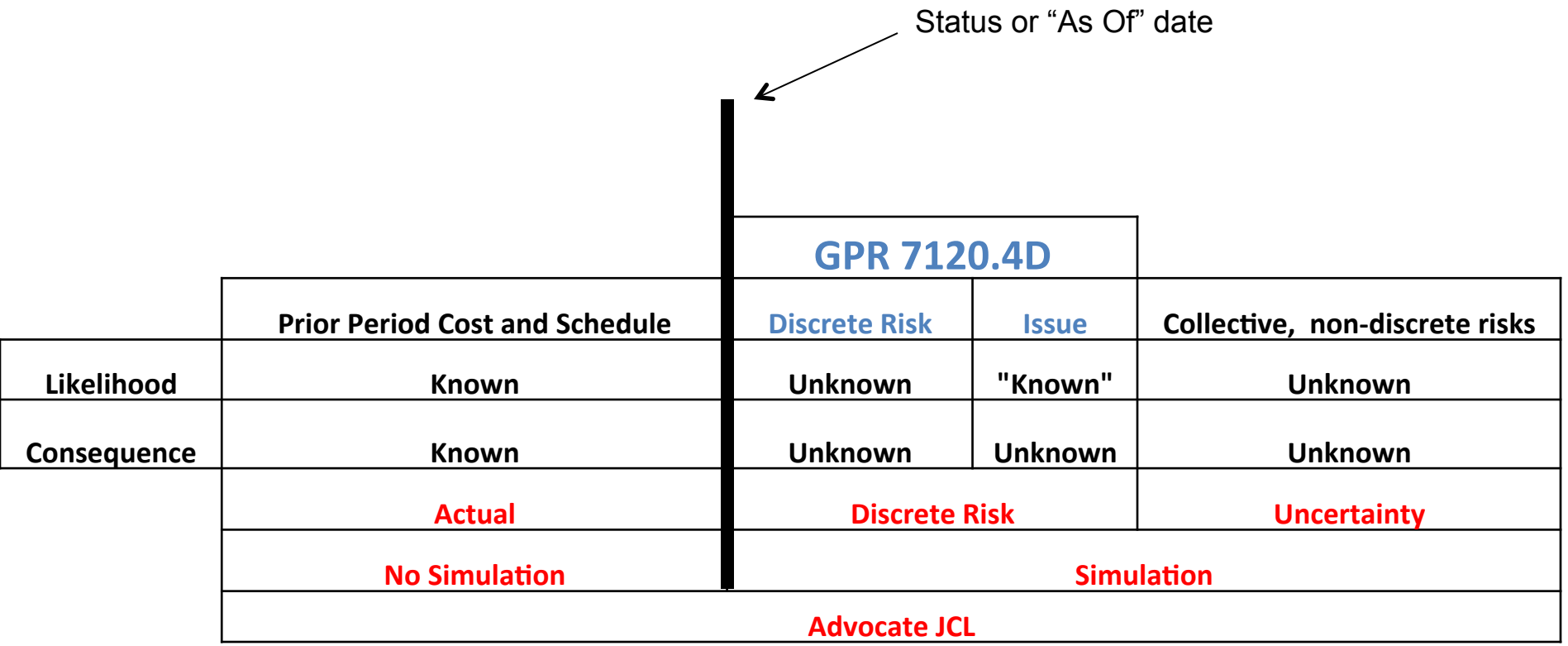
Risk Modeling via a Triangular Distribution

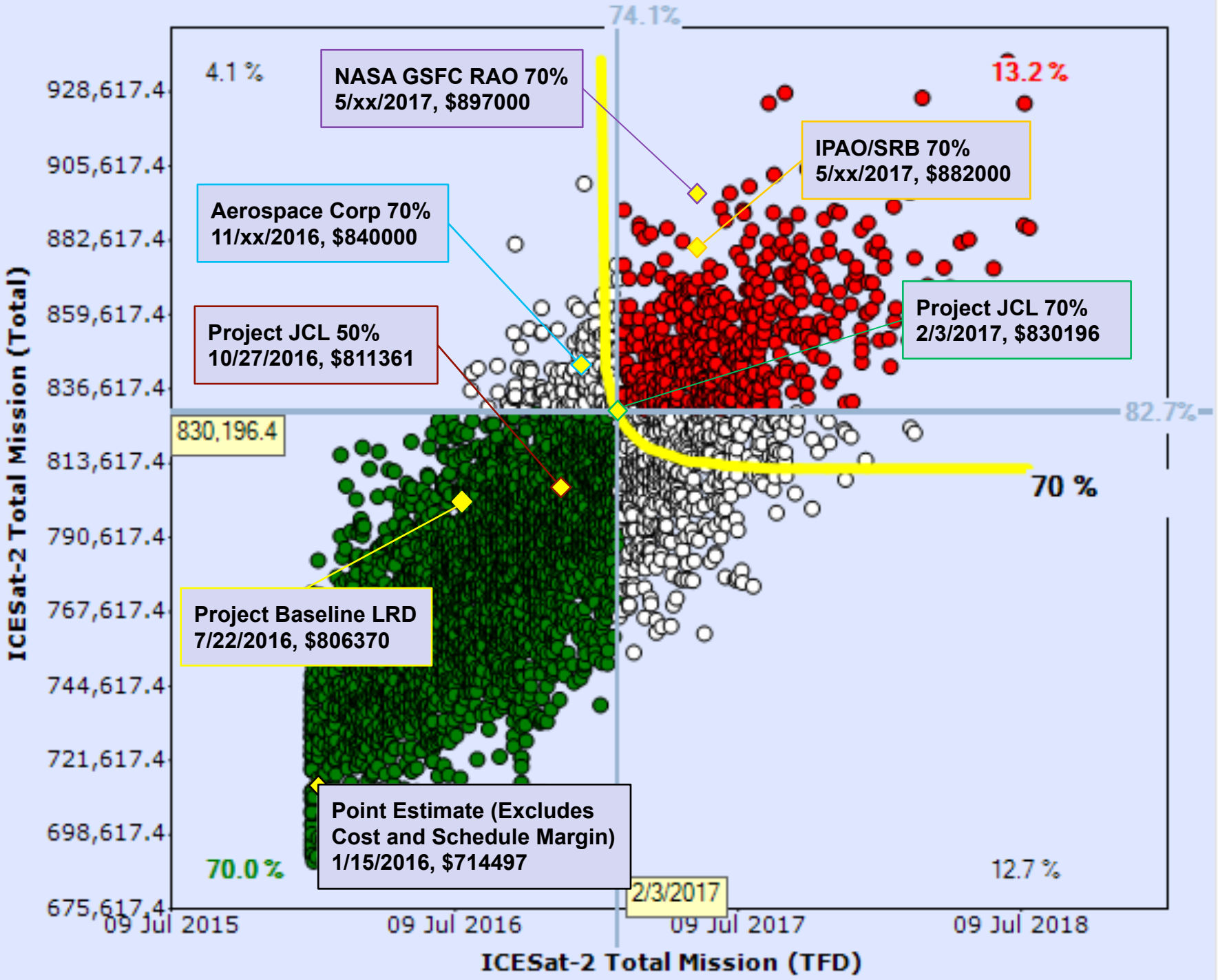


Q: How do we obtain these values to simulate threats?
A: Via a hierarchy:

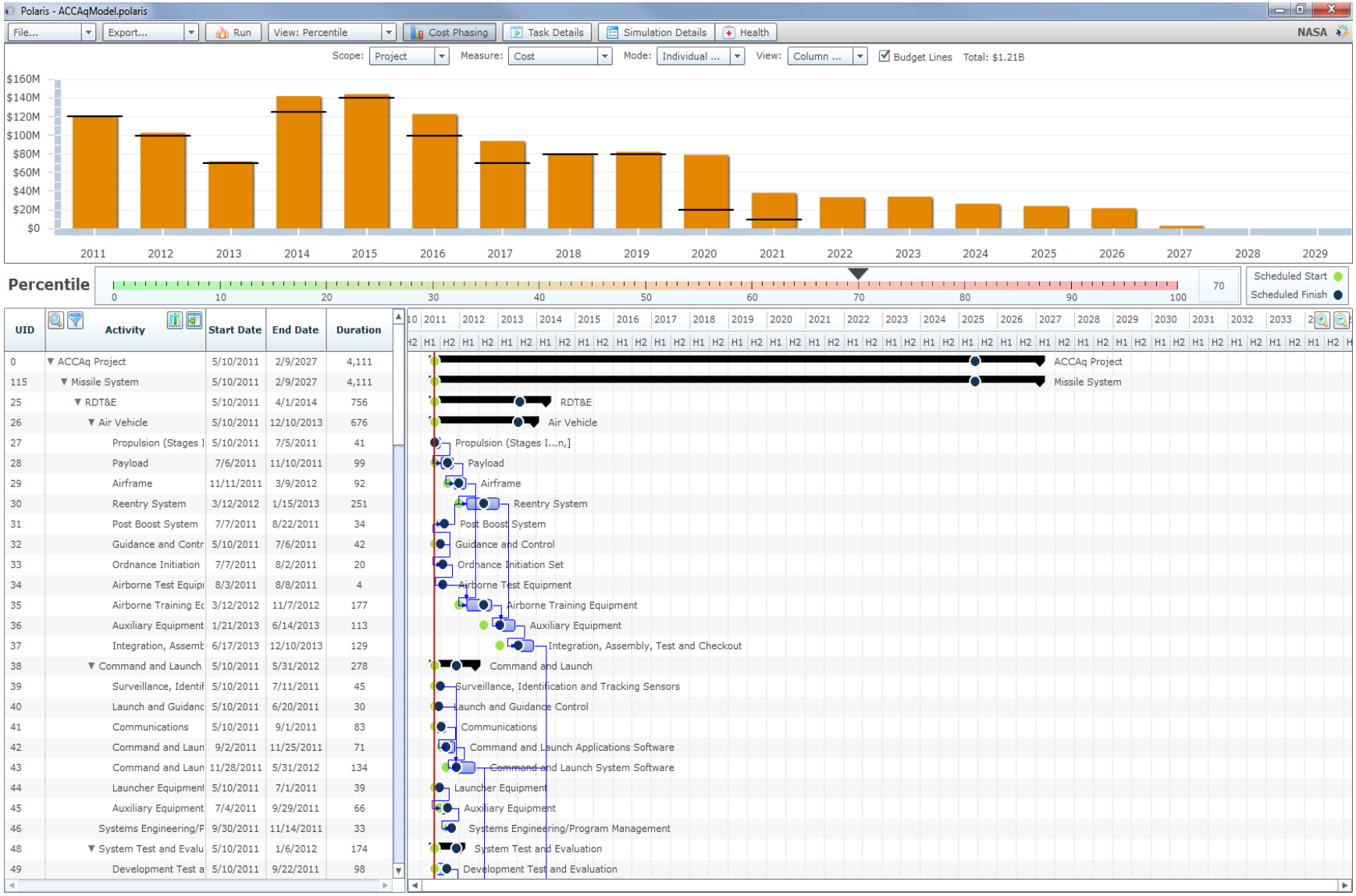
1) GSFC / Agency historical data
2) 3rd Party parametrically-derived values
3) Subject Matter Experts
4) Contractor estimates

JCL and GPR 7120.4D re: treatment of Discrete Risk and Uncertainty

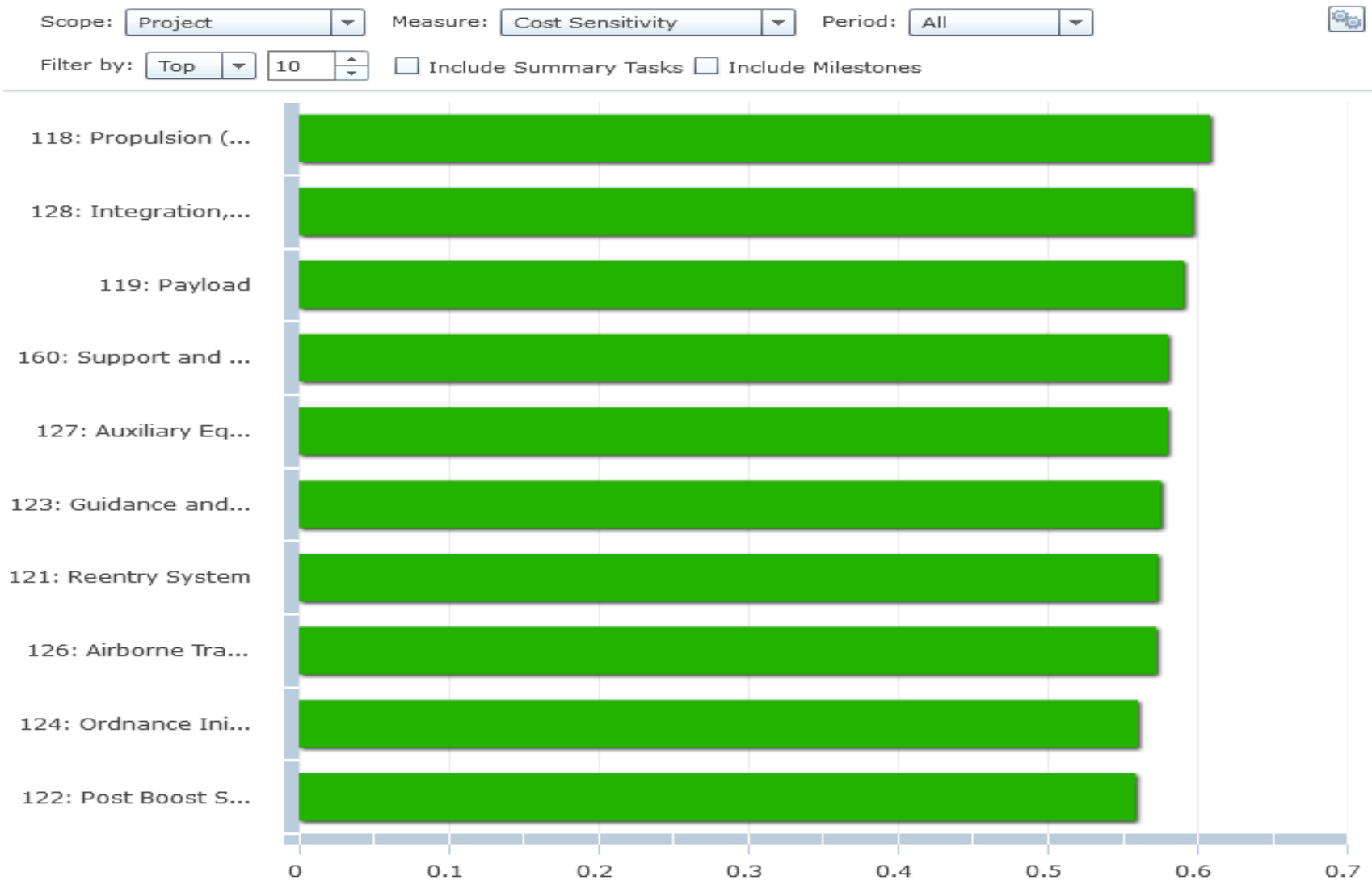



74.1%
4.1 %
13.2 %
NASA GSFC RAO 70%
5/xx/2017, $897000
IPAO/SRB 70%
5/xx/2017, $882000
Aerospace Corp 70%
11/xx/2016, $840000
Project JCL 70%
2/3/2017, $830196
Project JCL 50%
10/27/2016, $811361
82.7%
830,196.4
70 %
Project Baseline LRD
7/22/2016, $806370
Point Estimate (Excludes
Cost and Schedule Margin)
1/15/2016, $714497
70.0 %
12.7 %
2/3/2017
928,617.4
905,617.4
882,617.4
859,617.4
836,617.4
813,617.4
790,617.4
767,617.4
744,617.4
721,617.4
698,617.4
675,617.4
09 Jul 2015
09 Jul 2016
09 Jul 2017
09 Jul 2018
ICESat-2 Total Mission (Total)
ICESat-2 Total Mission (TFD)

Project Budgets and Annual Cash Flow

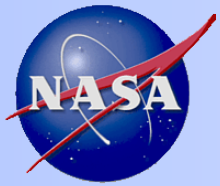


Cost Results – Tornado Chart



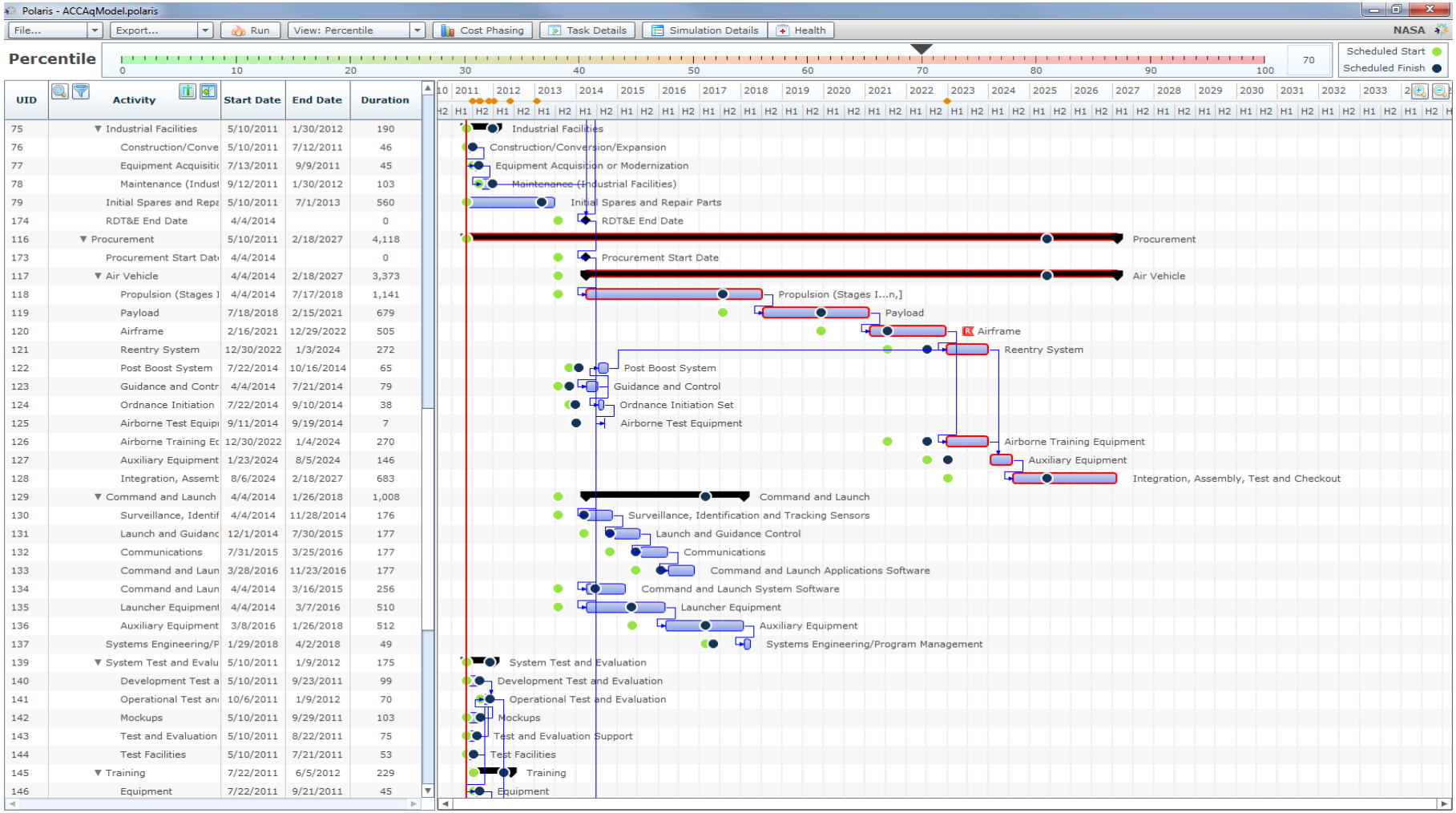
What JCL Can & Cannot Do

- JCL is the final integrated step in a series of analyses – it provides budgetary and operational insight
- JCL is no better than the quality of inputs and an adequate process can be rendered ineffective where
  - Baseline cost and schedules are inadequate/ flawed
  - Risks are incomplete or underscoped
  - Distributions are excessively narrow
  - Uncertainty beyond discrete risks is insufficient (or non-existent)
- There will be times when other considerations will, of necessity, become the primary basis for decision



BACKUP

Schedule Results – Critical Path Insight

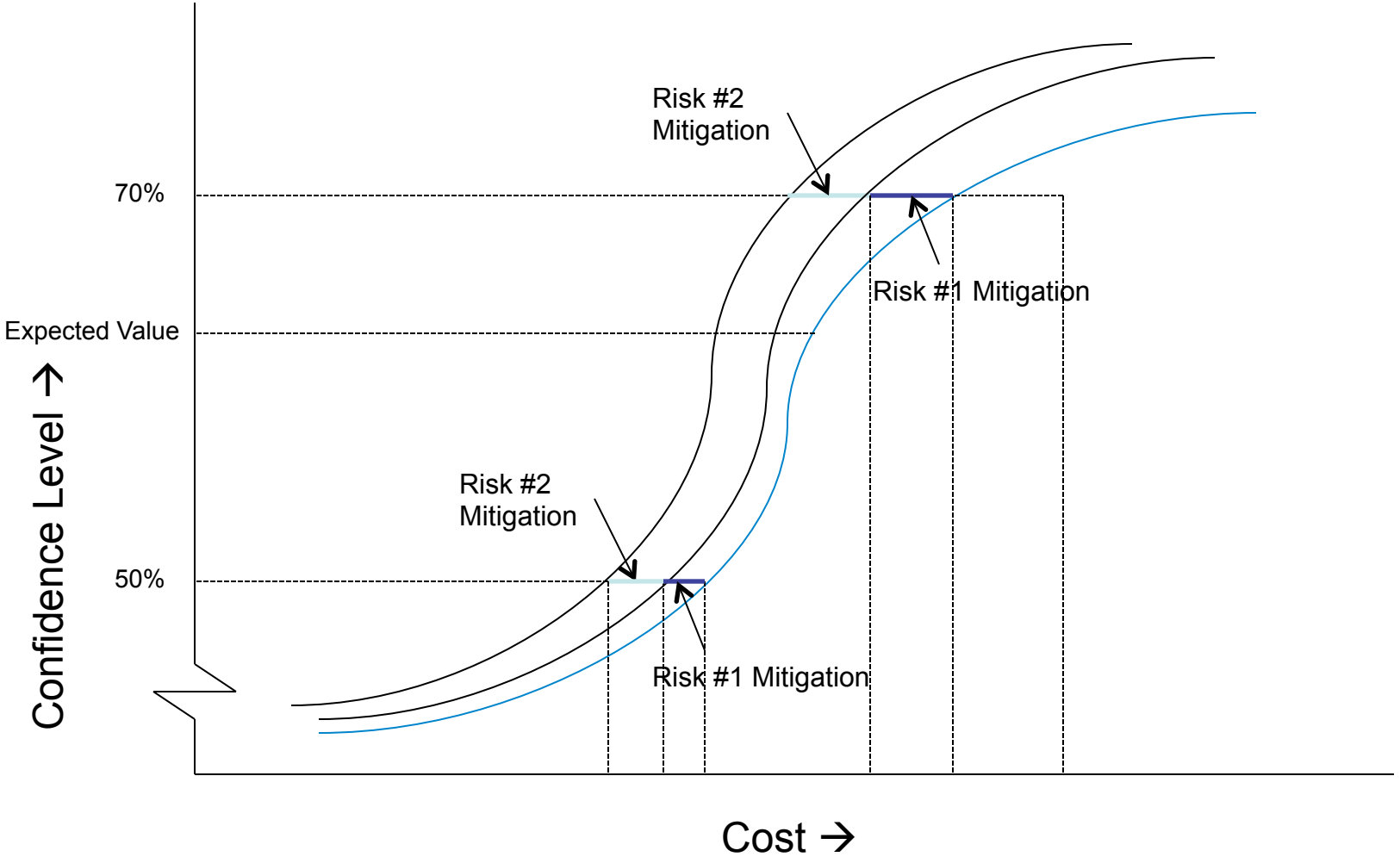


JCL Lessons Learned - Benefits

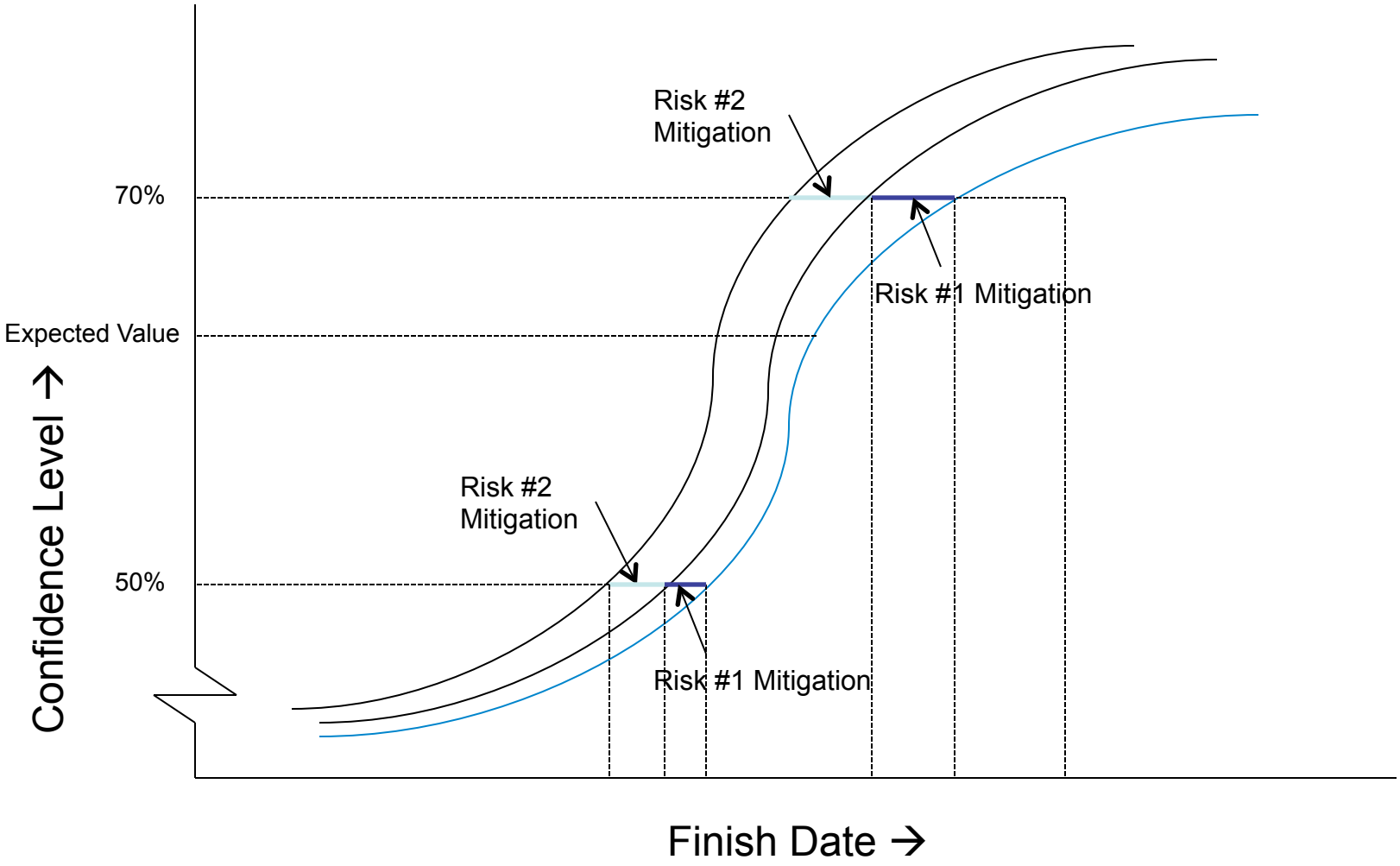
- Improves project planning by integrating cost, schedule, and risk products and processes
- Focuses on the inputs to project plans instead of the outputs
  - NASA management resonates with the discussion of specific technical and programmatic inputs
  - Facilitates better communication between the project and the independent review team
- Complements many of the Agency's existing systems and activities (e.g., Risk Management Systems, Earned Value Management)
- Reserve levels are not dictated by standards or rules of thumb, but derived from the project's unique technical and programmatic characteristics (treated as unfunded future expenses)
  - Facilitates better understanding and communication of project health to external stakeholders
- Incorporates schedule into the confidence level calculation
  - Genesis of Joint Cost and Schedule Confidence Level (JCL)
  - Forces project to address and understand time independent and time dependent costs
  - Enforces scheduling best practices (i.e., schedule health checks)
- Strengthens risk management
  - Quantifies risks in terms of cost and schedule impacts
  - Addresses risk realization instead of only risk mitigation

At Goddard, the Advocate JCL process is in its infancy but there's mounting evidence that it holds significant potential for budgetary and operational benefits. Once we climb higher on the learning curve, the same model can be both understood and have the support of both the project and the independent reviewers. This can boost ownership and commitment to meeting cost and schedule goals which is what the Business Change Initiative is endeavoring to target.

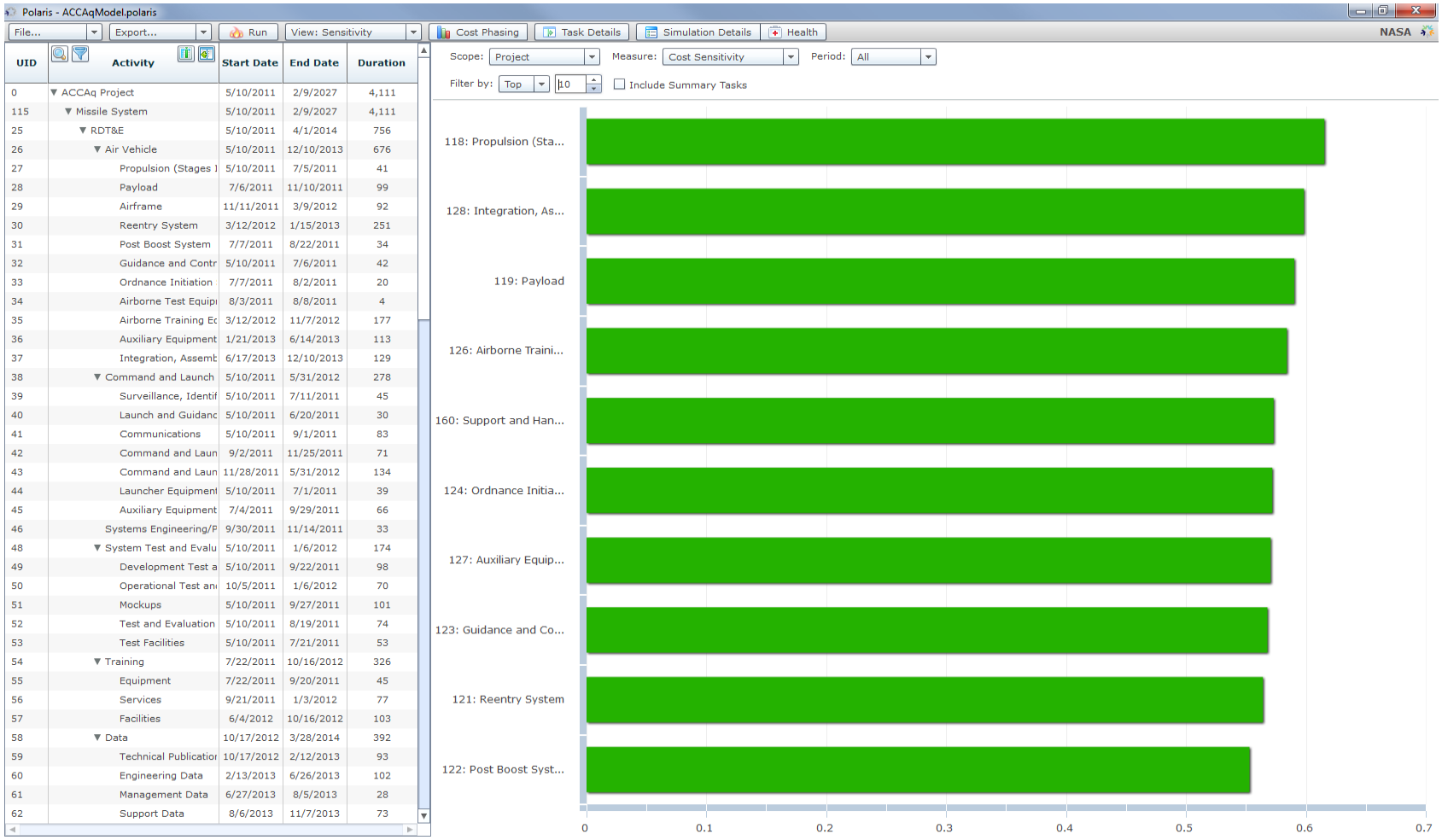
Cost Results – Risk Mitigation



Schedule Results – Risk Mitigation



Schedule Results – Tornado Chart



Recent GSFC JCL Schedule Compression

#	GSFC PROJECT	# LINES IN IMS	# LINES IN ANALYSIS SCHEDULE	NOTES
1	GEMS	3039	750	No IMS at start of JCL
2	SGSS	30,000+	265	
3	ICESat-2	20,389	301	IMS includes vendor schedules
4	Maven	None	190	IMS dated from CSR
4	JPSS Flight Segment	60,000+	390	
5	GOES-R (includes S, T, U and the Ground segment)	100,000+	1,571	JCL Analysis Schedule became program Integrated Program Master Schedule (IPMS)
6	OSIRIS-REx	10,336	810	

Discrete Risks on recent GSFC JCL Models

1	GEMS	33	39 risk impacts
2	MAVEN	24	30 risk impacts
3	GOES-R	38	Flight: 20 / Ground: 18
4	SGSS	16	45 risk impacts
5	JWST	60	Cost: 29 / Technical: 31
6	OSIRIS-REX	11	As of 3/22/2013
7	JPSS Flight Segment	35	46 risk impacts
8	ICESat-2	76	Programmatic (30), Technical (9), Cost (4), Schedule (8), Cost & Schedule (25)

Recent GSFC JCL Project Durations

1	GEMS	5 months	No initial IMS so data collection for three months + 2 months for JCL model completion.
2	SGSS	6 months	1 month of data collection / familiarization + 5 months for JCL model completion.
3	ICESat-2	9 months	JCL Kickoff in August 2011. Actually gained more JCL preparation time (15 months total) as the KDP-C slipped out due to project funding cuts.
4	JPSS Flight Segment	6.5 months	4 months to develop Analysis Schedule + 1.5 months to wire in risk, cost and uncertainty + 1 month for reviews and updates.
5	Maven	3.5 months	2.5 months to develop Analysis Schedule + 1 month to initial JCL model delivery to the SRB.
6	GOES-R (includes S, T, U and Ground segment)	9 months	6 months to develop the IPMS / Analysis Schedule + 2 months for JCL model development + 1 month for reviews & updates.
7	OSIRIS-REx	4 months to date; expected closure in one month	Work-in-process as of this writing.

The bulk of the time is for acquiring data; actual model development and execution is relatively low.

Recent GSFC JCL Project Team Involvement

#	GSFC Flight Project	Project Manager	DPMR	Systems Engineer	Discipline Expert	Scheduler / Planner	Risk Manager
1	SGSS	A	I	I	I	I	I
2	GEMS	A	I	A	A	I	
3	ICESat-2	A	I			I	I
4	JPSS Flight Segment	A	A	I	I	I	I
5	OSIRIS-REx	A	I	I	I	I	I

LEGEND: I = Involved A = Aware

Schedule Results – CDF